NASA TECH BRIEF

Marshall Space Flight Center

Magnetic-Doped Alloys With Very Large Seebeck Coefficients

It is well known that nonmagnetic metals (e.g. noble metals) doped with small concentrations of magnetic material exhibit very large Seebeck coefficients over a wide temperature range. As a result of this property, iron-doped gold has replaced chromel thermocouples and is now widely used as a sensitive thermometer for the liquid-helium to room-temperature range.

Because the coefficients of these alloys are orders of magnitude larger than those predicted from the simple free-electron models, an Fe-doped Ag_{1-x} Pd alloy has been studied between 4.2 to 520 K to establish an improved model. Results of this study indicate that this alloy exhibits a very large thermoelectric power and a resistance-minimum phenomenon (Kondo effect). The exchange scattering parameter and the Kondo temperature are 0.53 eV and 15 K, respectively. In the region above room temperature, this alloy shows a large negative thermoelectric output of -40 μV/K. The experimental results in conjunction with recent theories of thermoelectricity in the presence of s-d scattering suggest that the exchange parameter remains negative (antiferromagnetic) for all values of x between 0 and 1. This result contradicts the interpretation recently given to Kondo effect behavior in Fe doped $Cu_{1-x}Pd_x$ alloys in which a change in sign of the exchange parameter is suggested.

Preliminary results of this study also show that, based on the selection of magnetic solute and the nonmagnetic solvent from the periodic table, alloys having Seebeck coefficients approaching 100 μV/K can be obtained.

Note:

Requests for further information may be directed to:

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No patent action is contemplated by NASA.

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